Available Senior Projects for 2009/2010

Offered by Professor Tai-Ran Hsu

Project 1: Design and construct a regenerative braking system and test facility for light-weight electric vehicles running at low-speed, e.g., the ZEM (Zero Emission) vehicle (6 students)

The ZEM vehicle, which is powered by hybrid human pedaling/electric/solar photovoltaic was designed and constructed by previous senior design projects from 2006 to 2008. The objective of this project is to introduce yet another supplement power source of recoverable energy from decelerations and braking of the vehicle. This project will involve with the design and construct a bench-top testing facility for evaluating the feasibility of a new regenerative braking system (RBS) for light-weight electric vehicle running at low speed such as ZEM and other light utility and neighborhood electric vehicles. The basic concept of the RBS is developed in the summer of 2009 with a College of Engineering Faculty Development Grant. Work will also involve the testing and evaluation of the performance of a new integrated RBS-braking system for ZEM vehicle. A cost/benefit analysis will be a part of the deliverable.

Project 2: Design and construct a GO-cart with regenerative braking system (Sang Nguyen, Jeevan Athwal, Mitchell Borja plus two other students)

This project involves the design and construction of a special RBS for Go-carts with fast acceleration. It may be related to the work described in Project 1

Project 3: Design and construct wind deflectors and wind fences to mitigate and control turbulent wind flow over rooftops of high rise buildings in urban centers (6 students)

Wind power generation provides great potential to be major power supply to urban residents. Wind-power density is proportional to the cubic power of wind velocity, which increases with height. Wind-turbo generators installed on the rooftops of high-rise buildings should be able to take advantage of height without expensive full-size towers. However, in urban areas, the potential for turbulent flows generated from other obstructions are real and must be assessed and minimized before the potential for this type of wind-energy generation can be fully evaluated.

The objective of this project is to design and test wind deflectors of three specific geometries for their effectiveness in mitigating turbulent wind flow patterns over rooftops of high rise buildings in urban center. These deflectors with proper geometry and dimensions can mitigate such turbulence and make available rooftops of high rise building suitable for wind power generation in proximity of end users in urban centers. Wind fences will be used to provide local control of wind flows to the wind turbines on rooftops. Students will use available CFD code to design these wind deflectors and wind fences for performance, and the ProE/Pro-mechanica to assess the induced vibration and noise generation of wind turbines over rooftops. Field tests at rooftop of a selected building on campus will be conducted for the wind deflectors and fences designed and constructed in this project.

Project 4: Design and construct a low-power wide cross-section wind tunnel for wind power generation in urban centers (4 students)

Wind flow pattern is a major factor on the performance of wind turbo generators. Wind turbines are typically operating between wind velocity between 3.5 m/s to 15 m/s, and they are much bigger than airfoil or automobiles that are commonly tested in wind tunnels. The objective of this project is to design and construct a low-speed wind tunnel with wide cross-sectional area of the test section that can accommodate scaled-down wind turbines and wind turbine over rooftops of high rise buildings in selected area in urban centers. Special instruments are required for this type of wind tunnels.

Project 5: Design hybrid solar/wind power generations on rooftops of high rise buildings (4 students)

Hybrid solar- and wind-power generations over rooftops of high-rise buildings in urban centers can potentially provide reliable and continuous power supply to end users in close proximity. Because the energy is generated on site, it reduces the need for transmission, it reduces transmission losses, and it eliminates the need for materials such as wiring and poles.

The objective of this project is to develop design methodology for optimal combinations of energy supplies in hybrid solar/wind power generations over given rooftops of high rise building in urban centers. Students will be required to conduct research on the regional wind speed and climatology to develop optimal combinations of energy sources of solar and wind for the particular sites. Cost/benefit analysis is an important part of such design.

Reliability, safety and structure integrity of the rooftops are other major concerns by the owners of the buildings and the general public with hybrid solar/wind power generations on rooftops of high rise buildings in urban centers. These concerns must be addressed in the project.

Project 6: Design pilot wind farm for IBM-Almaden Research Center (ARC) in San Jose (3 students)

This project is a continuation of work performed by a team of six students in AY 08/09. Work will involve monitoring wind speed measurements by anemometers installed by previous year student team at the IBM-ARC site, and design a wind farm with optimal number of small wind turbo generators and energy storage and exchange system with the PG&E. A cost/benefits analysis of the wind farm in the 2000 plus acres of undeveloped site will be part of the deliverable. This project is supported by the IBM-ARC.